

III. Remarks

A. Claim Objections

The Action objects to Claims 37-46 for reciting “the method” in the preamble. These claims have been amended as suggested by the Examiner and now recite “The planarized final copper structure.” Accordingly, withdrawal of the objection is respectfully requested.

B. Claim Rejection under § 112

The Action rejects Claims 36-46 as being indefinite for having insufficient antecedent basis for the limitation “the ambient atmosphere” in Claim 35. Reconsideration of this rejection is respectfully requested.

“[F]ailure to provide explicit antecedent basis for terms does not always render a claim indefinite. If the scope of a claim would be reasonably ascertainable by those skilled in the art, then the claim is not indefinite.” MPEP 2173.05(e) An example of when antecedent basis need not be provided is with inherent components of elements recited in the claims, e.g., “the outer surface” of a sphere needs no antecedent basis. *Id.* (citing *Bose Corp. v. JBL, Inc.*, 274 F.3d 1354, 1359, 61 USPQ2d 1216, 1218-1219 (Fed. Cir. 2001)).

It is submitted that one of ordinary skill would understand the recited structure to have an “ambient atmosphere”, akin to a sphere having an outer surface, and that, therefore, the claim scope is “reasonably ascertainable by those skilled in the art.” Reconsideration and withdrawal of this rejection, therefore, is respectfully requested.

C. Claim Rejection Under §103

The Action rejects Claim 36-45 as being obvious in view of U.S. Patent No. 6,475,909 to Uozumi. In the rejection, the Examiner concludes that Uozumi teaches all of the features recited by the Applicants in these claims except for the specific depth for the lower recessed copper structure 3 or a specific thickness for the barrier metal layer 2. Reconsideration and withdrawal of this rejection are respectfully requested in view of the following arguments.

Uozumi forms its final structure shown in FIG. 1D by: (a) forming a copper film 5 on the surface of copper film 3 (FIG. 1B); (b) etching the oxide film 5 to recess the copper film 3 (FIG. 1C); and (c) depositing a barrier metal layer on the upper portion of the copper layer 3 and polishing the deposited barrier metal layer to form the structure of FIG. 1D. (Column 7, Lines 51-61).

Uozumi describes its invention as lying “in its method of etching a copper film without roughening the copper surface. That is, an oxide film including an ammonia complex is formed on the surface of the copper film and is then etched out.” (Column 9, Lines 53-56). The etching process used to remove the oxide film is stated as having an “**oxidizing property**”. (See, e.g., Column 9, Line 62).

It is submitted that because Uozumi uses an etch process that has an “oxidizing property” and discloses no intermediate process step between this etch process and the metal cap layer deposition process, the structure of Uozumi likely does not have “the lower, recessed copper structure having a copper oxide-free upper surface” as recited in the claims. In the examples provided by Uozumi, e.g., Examples 1-4, Uozumi uses an aqueous ammonia (NH_3) and/or hydrogen peroxide (H_2O_2) etchant solutions to form the etched copper structure of FIG. 1C and to purportedly remove the oxide layer 5. (See, e.g., Column 9, Lines 62-63; Column 10, Lines 4-16 and 58-65; Column 11, Lines 13-23; and Column 12, Lines 28-30).

Applicants have disclosed at Pages 8-9 of the Specification, under the heading “Formation of Recessed Copper Structure 18’,” aqueous etchant methods using ammonia (NH_3) and hydrogen peroxide (H_2O_2). After these steps, however, Applicants have found it advantageous to employ a reducing treatment to remove any copper oxide formed on the surface of the recessed copper structure 18’ by these etchant methods, which Uozumi confirms are “oxidizing”. In one embodiment, the reducing treatment utilizes a plasma treatment. In this manner, Applicants’ claimed structure is formed having a “copper oxide-free upper surface,” over which the recited conductor film is formed.

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In summary, Applicants submit that although Uozumi removes its oxide film 5, which is intentionally formed on the upper copper surface, it does not teach or suggest the additional step of removing copper oxides which remain after the etching step and before deposition of the upper conductive film. For this reason, it is submitted Uozumi does not teach the recited structure having **a copper oxide-free upper surface**.

For at least the foregoing reasons, it is submitted that Claim 36 and Claims 37-46, which depend from Claim 36, are allowable over the art of record. Reconsideration and withdrawal of this rejections are respectfully requested.

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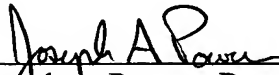
IV. Conclusion

In view of the foregoing remarks and amendments, Applicants submit that this application is in condition for allowance at an early date, which action is earnestly solicited.

The Commissioner for Patents is hereby authorized to charge any additional fees or credit any excess payment that may be associated with this communication to deposit account **04-1679**.

Respectfully submitted,

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